Claims:

1. A method of dose delivery of radiation comprising the steps of:

determining an objective function to be used for mapping radiation beams to a body volume comprising at least one target volume, and at least one non-target volume, the objective function comprising a first term related to the at least one target volume and a second term related to the at least one non-target volume;

determining a minimum of the objective function whereby beams mapped so as to pass through the at least one non-target volume are limited such that the second term is zero only if the weights of beamlets passing through the at least one non-target volume are zero; and

delivering radiation based on the determined minimum of the objective function.

2. The method of claim 1, wherein the second term comprises, for all of a plurality of non-target volume portions, a non-target volume sum of beamlet sums related to respective non-target volume portions, each beamlet sum being a sum of the product of the squared weight of the beamlet with the squared planned radiation dose deposit at the respective non-target volume portion.

3. The method of claim 1, wherein the objective function further comprises a third term related to an organ-at-risk (OAR) volume and wherein the third term comprises, for all of a plurality of OAR volume portions, an OAR sum of beamlet sums related to respective OAR volume portions, each beamlet sum being a sum of the product of the squared weight of the beamlet with the squared planned radiation dose deposit at the respective OAR volume portion.

4. The method of claim 1, wherein the objective function further comprises a symmetry term for enabling symmetrical dose delivery about an axis of the at least one target volume.

5. The method of claim 4, wherein the symmetry term is of the form:

$$O_{SYM} = \sum_{i}^{all-beamlets} \left(w_i^2 - w_i\right)$$

where O_{SYM} is the symmetry term, and

w_i is the weight of beamlet i of a plurality of radiation beams.

6. The method of claim 4, wherein the symmetry term is positive and its minimum is zero when $w_i = 1$ for all i, where w_i is the weight of beamlet i of a plurality of radiation beams.

7. The method of claim 1, wherein the step of determining a minimum includes solving a linear system of equations to determine the weights of the beamlets.

8. The method of claim 7, wherein the solution of the linear system of equations is generated using matrix inversion of a beamlet intersection matrix for each beamlet.

9. The method of claim 8, wherein the solution of the linear system of equations is generated by the product of the inverted beamlet intersection matrix with a beamlet dose deposit array.

10. The method of claim 8, wherein the beamlet intersection matrix comprises a sum of organ volume matrices respectively corresponding to the at least one target volume and the at least one non-target volume, each organ volume matrix being weighted by a respective importance parameter.

11. The method of claim 10, wherein the beamlet intersection matrix further comprises a symmetry term having a symmetry importance parameter for weighting the symmetry term.

12. The method of claim 1, further comprising:

receiving contour data relating to a two-dimensional contour of the at least one target volume or the at least one non-target volume;

determining from the contour data whether the contour is oriented clockwise or anti-clockwise; and

if the contour is determined to be anti-clockwise, changing the order of the contour data so that the contour is oriented clockwise.

13. The method of claim 12, wherein determining whether the contour is oriented clockwise or anti-clockwise further comprises:

a) determining a topmost vertex of the contour;

b) determining a lowermost vertex of the contour;

c) determining a rightmost vertex of the contour that is neither the topmost or lowermost vertex;

d) determining a leftmost vertex of the contour that is neither the topmost or lowermost vertex; and

e) determining the contour orientation according to the relative clockwise order of the topmost, lowermost, rightmost and leftmost vertices with respect to each other.

14. The method of claim 12, further comprising:

extrapolating a continuous contour from the contour data;

determining all right and left boundaries of the continuous contour; and

determining a cell of the body volume to be within the continuous contour if the cell lies between a facing pair of right and left boundaries.

15. The method of claim 14, wherein a boundary is determined to be a left boundary if the contour data indicates an upwardly extending sequence of

contour points and a boundary is determined to be a right boundary if the contour data indicates a downwardly extending sequence of contour points. .

16. The method of claim 1, wherein said body volume is virtually divided into a plurality of cells of a predetermined size and said radiation beams are mapped to said body volume such that fractions of the radiation beams are dimensioned proportionally to the size of said cells.

17. The method of claim 16, wherein said fractions are resolved into linearly sequential portions of non-uniform size.

18. The method of claim 17, wherein a linear dimension of said sequential portions is uniform and is 1 to 2 times a width dimension of said cells.

19. The method of claim 18, wherein said linear dimension is about 1.25 times said width dimension.

20. The method of claim 1, wherein the dose delivery of radiation comprises intensity-modulated radiation therapy.

21. The method of claim 1, wherein the dose delivery of radiation comprises Tomotherapy.

22. A method of determining an objective function to be used for mapping radiation beams to a body volume comprising at least one target volume and at least one non-target volume, the objective function comprising a first term related to the at least one target volume and a second term related to the at least one non-target volume, the method comprising:

determining a minimum of the objective function whereby beams mapped so as to pass through the at least one non-target volume are limited such that the second term is zero only if intensities of beamlets passing through the at least one non-target volume are zero.

23. The method of claim 22, wherein the second term comprises, for all of a plurality of non-target volume portions, a non-target volume sum of beamlet sums related to respective non-target volume portions, each beamlet sum being a sum of the product of the squared weight of the beamlet with the squared planned radiation dose deposit at the respective non-target volume portion.

24. The method of claim 22, wherein the objective function further comprises a third term related to an organ-at-risk (OAR) volume and wherein the third term comprises, for all of a plurality of OAR volume portions, an OAR sum of beamlet sums related to respective OAR volume portions, each beamlet sum being a sum of the product of the squared weight of the beamlet with the squared planned radiation dose deposit at the respective OAR volume portion.

25. The method of claim 22, wherein the objective function further comprises a symmetry term for enabling symmetrical dose delivery about an axis of the at least one target volume.

26. The method of claim 25 wherein the symmetry term is of the form:

$$O_{SYM} = \sum_{i}^{all-beamlets} \left(w_i^2 - w_i\right)$$

where O_{SYM} is the symmetry term, and

w_i is the weight of beamlet i of a plurality of radiation beams.

27. The method of claim 25, wherein the symmetry term is positive and its minimum is zero when $w_i = 1$ for all i, where w_i is the weight of beamlet i of a plurality of radiation beams.

28. The method of claim 22, wherein the dose delivery of radiation comprises intensity-modulated radiation therapy.

29. The method of claim 22, wherein the dose delivery of radiation comprises Tomotherapy.

30. A method of providing radiation, comprising:

determining an objective function for optimizing radiation dose delivery to a target volume, the objective function having a symmetry term for enabling symmetrical dose delivery about an axis of the target volume; and

providing radiation based on the objective function.

31. The method of claim 30, wherein the symmetry term is of the form:

$$O_{SYM} = \sum_{i}^{all-beamlets} \left(w_i^2 - w_i\right)$$

where O_{SYM} is the symmetry term, and

w_i is the weight of beamlet i of a plurality of radiation beams.

32. The method of claim 30, wherein the symmetry term is positive and its minimum is zero when $w_i = 1$ for all i, where w_i is the weight of beamlet i of a plurality of radiation beams.

33. The method of claim 30, wherein providing radiation comprises providing intensity-modulated radiation therapy.

34. The method of claim 30, wherein providing radiation comprises providing Tomotherapy.

35. A system for optimizing dose delivery of radiation comprising:

computer processing means for determining an objective function to be used for mapping radiation beams to a body volume comprising at least one

target volume, and at least one non-target volume, the objective function comprising a first term related to the at least one target volume and a second term related to the at least one non-target volume, the computer processing means being arranged to determine a minimum of the objective function whereby beams mapped so as to pass through the at least one non-target volume are limited such that the second term is zero only if the weights of beamlets passing through the at least one non-target volume are zero; and

data communication means operably associated with the computer processing means for providing data to a radiation delivery apparatus for delivering radiation to the body volume based on the determined minimum of the objective function.

36. The system of claim 35, wherein the dose delivery of radiation comprises intensity-modulated radiation therapy.

37. The system of claim 35, wherein the dose delivery of radiation comprises Tomotherapy.

38. Computer readable storage having stored thereon computer program instructions executable on a computer system for causing the computer system to perform a method comprising:

determining an objective function to be used for mapping radiation beams for a body volume comprising at least one target volume and at least one non-target volume, the objective function comprising a first term related to the at least one target volume and a second term related to the at least one non-target volume; and

determining a minimum of the objective function whereby beams mapped so as to pass through at least one non-target volume are limited such that the second term is zero only if intensities if beamlets passing through the at least one non-target volume are zero.

39. The method of claim 10, wherein the importance parameter weighting each organ volume matrix is determined according to a function of position within the respective organ volume.

40. The method of claim 10, wherein each importance parameter has a predetermined value.